

UNITED STATES PATENT OFFICE

2,432,215

TEMPERATURE RESPONSIVE CONTROL
SYSTEM FOR PRESSES

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Application January 12, 1944, Serial No. 517,965

8 Claims. (Cl. 18-17)

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The present invention relates to control systems, and more particularly to a control system in which a press is opened and closed in accordance with a predetermined schedule and in accordance with the temperature of the press.

In the operation of moulding presses it is customary to bring them up to temperature prior to the time they are closed. The presses are then closed and held in that position long enough for the moulding operation to take place. At the end of this time a cooling medium is introduced in the press to cool it down and the press is then opened. Thereafter the press is heated up in preparation for another cycle.

It is an object of the present invention to provide a control system in which the above cycle of operations may be accurately carried out with a minimum of simple equipment. It is a further object of the invention to provide a control system in combination with a pneumatically operated press to control the temperature of the press as well as the opening and closing of the same. While the press is shown herein as being opened and closed by pneumatic means it will be obvious that hydraulic opening and closing means could also be used if desired.

In some cases it is only necessary that the press be brought up to at least some predetermined temperature while the moulding operation is taking place. In other cases it is necessary that the temperature of the press be maintained at some predetermined temperature while the moulding is taking place. The control system of my invention also contemplates the control of the temperature of the press as well as the maintenance of a maximum and of a minimum temperature therein.

The various features of novelty which characterize this invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects obtained with its use, reference should be had to the accompanying drawings and descriptive matter in which is illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a diagrammatic view of one embodiment of the invention and

Figure 2 is a view showing a second embodiment of the invention.

Referring to the drawings, there is diagrammatically shown a moulding press having a stationary part 1, and a moving part 2 that is raised

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and lowered with respect to the part 1 by means of the plunger 3 which has a piston 4 formed on the upper end thereof. The piston is received in a cylinder 5 that has air under pressure supplied to either its upper end through a pipe 6 or to its lower end through a pipe 7. The pipes have in them three-way solenoid valves 8 and 9, respectively, which valves are operated to either connect the air supply to the respective cylinder ends or to connect the ends of the cylinder with the atmosphere. The valve 8 in its normal unenergized condition connects the upper end of the cylinder with the atmosphere, while the valve 9 in its normal unenergized condition connects the lower end of the cylinder with the air supply, so that normally the press is open.

The press is supplied with a heating and with a cooling medium, depending upon the portion of the cycle, through a pipe 11 that connects directly with the lower portion 1 of the press. The upper portion 2 of the press is supplied with the same medium through a flexible pipe 12 that joins with the pipe 11. The pipe 12 is sufficiently flexible so that the portion 2 may be raised and lowered without breaking the connection. Steam or hot water is supplied to the pipe 11 through a pipe 13 and cooling water is supplied to the pipe 11 through a pipe 14. The junction of the pipes 11, 13 and 14 is controlled by a pneumatically operated three-way valve 15 which is spring operated in a direction to connect pipes 11 and 14 and which may be moved by means of air pressure applied above its diaphragm to a position in which pipes 11 and 13 are connected. Air is supplied to the valve 15 through a pipe 17 which has in it a three-way solenoid valve 16. This valve in its normal deenergized position connects the pipe 17 to the atmosphere. When the valve 16 is energized air is supplied through the pipe 17 to the valve 15.

The temperature of the press is measured by any suitable means which is shown herein as being a thermometer bulb 18 that is placed in the stationary portion of the press 1. This bulb is connected by means of a capillary tube 19 to a Bourdon tube 21, the outer free end of which has mounted upon it a double flapper 22. As the temperature of the press increases or decreases the Bourdon tube will unwind or wind to move the flapper 22 back and forth between a pair of nozzles 20 and 20A, respectively, which are supplied with air from a pipe 40 through a divided air line and through suitable restrictions leading to these nozzles. As the air flowing through the nozzles is throttled, it serves to operate one or

the other of a pair of pressure operated switch units 23 or 24. These switch units are identical in that each consists of an expansible bellows 25 that serves to move a switch supporting arm 26 against the tension of a spring 29. The unit 23 is provided with a switch 27 that is closed when the bellows expands and the unit 24 is provided with a switch 28 that closes when the bellows of that unit expands. The point at which the flapper 22 will cooperate with the nozzle 20 or 20A, and therefore the temperature of the press at which the switches 27 and 28 will be closed, may be regulated by adjusting the nozzles closer together or further apart.

Operation of the switches 27 and 28 serves to regulate either directly or indirectly the operation of a pair of relays A and B. The relay A is operated in one direction by a coil 31 and in the opposite direction by a coil 32. As these coils are energized, a solenoid core 33 is moved to either close or open a switch 34, respectively. The second relay B consists of coils 35 and 36 which when operated serve to move a solenoid core 37 in a direction to open or close a switch 38, respectively. It is noted that these relays are so designed that the switches will remain closed after the coils 31 or 35 have once been energized, and will remain open after the coils 32 and 36 have once been energized, even though these coils may later become deenergized.

There is also included in the control system a timer 39 which may be of any suitable commercial type that will close one switch during the timing period and close another switch when the timing period is over and that will automatically reset itself at the end of a cycle. As shown herein, the timer has a clutch coil 41 that operates a holding switch 42. The timer also has a motor 43 which operates a switch arm 44 to move the latter into engagement with a contact 45 during the timing period and to move it into engagement with a contact 46 when the timing period is terminated. The timer is also provided with a manually operated switch 47 to start the timing cycle. A signal light 48 is provided in the system to indicate when the apparatus is in condition to be operated.

In the operation of the system, at the termination of a cycle, the switch 38 is closed to energize the solenoid valve 16 so that air will be supplied through the pipe 17 to the valve 15. In this way the steam or hot water supply to the press is turned on so that the press will be heated to its proper temperature before a new operation is performed therewith. When the press has reached the temperature for which the system has been adjusted, the Bourdon tube 21 will expand enough to move the flapper 22 into engagement with the nozzle 20 and stop the flow of air therethrough. Bellows 25 will accordingly be expanded to close switch 27. This closes a circuit from one side of the line through wire 51, switch 27, wire 52, signal light 48 and wire 58 to the other side of the line; the light indicating that the press is at the proper temperature. This circuit also sets up an energizing circuit for the timer push button 47. Thereafter when the press has been placed in readiness for operation, the operator will push the button 47, energizing the clutch coil 41 through the previously mentioned circuit consisting of wire 51, switch 27 and wire 52 to the push button and clutch coil and back to the line through wire 53. The motor 43 of the timer is also started by this operation bringing the switch arm 44 into engagement with contact 45. This closes a circuit

to energize the coil 31 of relay A through wires 51, wire 54, switch 44, 45, coil 31 and wire 58 to the line to close the switch 34. Closing of that switch forms a holding circuit for the clutch 41 through the timing contact 42 of the timer. The closing of switch 34 also serves to energize the solenoids 8 and 9 by closing a circuit from one side of the line through switch 34, wire 55, the solenoids 8 and 9 and wire 56 to the other side of the line. Energization of the solenoid 9 disconnects the supply of air through pipe 7 and connects the lower end of the cylinder 5 to the atmosphere. Energization of the solenoid 8 connects the upper end of the cylinder 5 with the air supply through pipe 6 so that the press part 2 is lowered. This condition continues as long as the timer remains in its present condition.

When the timing period has terminated the motor 43 of the timer will move the switch blade 44 out of engagement with the contact 45 and move it into engagement with the contact 46. This serves to energize the coil 35 of relay B through a circuit consisting of wire 51, wire 54, blade 44, contact 46, the wire 57, the coil 35 and wire 58 back to the other side of the line. The energization of this coil opens switch 38 to deenergize solenoid valve 16 thereby cutting off the supply of air through pipe 17 and connecting that pipe with the atmosphere. As a result of this the spring in valve 15 will move the valve plunger to a position so that the cooling water may be supplied to the press.

After the press has cooled down sufficiently, the Bourdon tube 21 will wind up enough to move flapper 22 into engagement with nozzle 20A. This stops the flow of air through the nozzle and causes the bellows 25 of switch unit 24 to expand sufficiently to close switch 28, thereby closing a circuit which will energize solenoid coils 32 and 36. Energization of the coil 32 is completed through wire 51, switch 28, coil 32 and wire 58 to the other side of the line and serves to open the switch 34. Such operation breaks the holding circuit for timer switch 42 and deenergizes the timer 39 which automatically resets itself in condition for another cycle to take place. Opening the switch 34 also serves to deenergize solenoid valves 8 and 9 thereby connecting the upper end of the cylinder 5 with the atmosphere and the lower end of cylinder 5 with the supply of air through pipe 7 thereby raising the part 2 of the press out of engagement with part 1. The energization of coil 36 will cause the solenoid core 37 to move to the right and close switch 38 to energize solenoid valve 16. This connects the pipe 17 with the supply of air so that valve 15 will be moved to a position to connect pipes 13 and 11 thereby permitting a supply of steam or hot water to go to the press so that the press will be heated up in readiness for another cycle of operation.

From the above description it will be seen that a cycle of operation is started by pressing the starting button 47 of the timer and this may be done any time after the signal 48 is turned on to indicate that the press is up to temperature. When a cycle of operation is started the press parts are moved together for the moulding operation to take place at the proper temperature. A predetermined time after the press is closed the heat is turned off and the cooling water is turned on. When the press has cooled down to some predetermined degree it is automatically opened to complete the cycle. As the press opens the steam is turned on again to heat it up in preparation for another cycle.

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In the system shown in Figure 1 and described above, the switch 27 was operated when the temperature reached a predetermined maximum value and no means is provided to control this temperature, which may rise to the value of the temperature of the hot water or steam in pipe 13. In some cases it may be desirable to control the temperature of the press to some given value rather than just keep it above a minimum value. When such a system is desired the construction shown in Figure 2 may be used in connection with that of Figure 1. As shown in Figure 2, a steam valve 61 is placed in the pipe 13 ahead of the three way valve 15. This valve is of the type which closes with an increase of pressure applied to its diaphragm and this pressure is applied through a pipe 62 from a temperature control instrument 63 that may take the form of the controller which is described in detail in Moore Patent 2,125,081 that issued on July 26, 1938. With this system the pressure operated switch unit 23 is connected to the pipe 62 and functions in exactly the same manner as it did in the previously described case. As a matter of fact the system of Figure 2 is exactly the same as that of Figure 1 with the addition of a control instrument and an air operated valve. In the operation of this system the temperature of the press as measured from the responsive bulb 18 is controlled by the amount of steam which is supplied through pipe 13. As the temperature of the press varies, the control instrument 63 operates to vary the pressure of the air supplied to it by pipe 40 and from it through pipe 62, to vary the opening of valve 61. The pressure responsive switch 23 is in this case responsive to the pressure in pipe 62, since when the temperature of the press has reached some predetermined point the pressure in the pipe 62 will have increased to a point where the switch 27 will be closed to initiate the operation described in connection with Figure 1. Thereafter the pressure in the pipe 62 is varied in accordance with the temperature of the press to maintain that temperature at some predetermined value. The various pressures in the pipe 62 will not have any effect upon the operation of the remainder of the system, since after the timer 39 has been started and the switch 34 closed, a holding circuit which is independent of the switch 27 is applied through the switch 34. The minimum temperature operated switch unit 24 can either be operated from an entirely separate temperature system from that which is used in connection with the controller 63 or, as would probably be the case in most commercial instruments, it may be combined with the mechanism in the instrument 63 so that a single temperature responsive system can be used to control two air pressures, one which increases the pressure as the temperature of the press increases to control the valve 61 and the switch unit 23 and the other of which increases the pressure in this system when the temperature of the press decreases in order to control the switch unit 24.

From the above description it will be seen that I have provided a control system to control the temperature and the operation of a moulding press which system is simple and completely automatic to regulate the operation and temperature of the press.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of my invention now known to me, it will be apparent to those skilled in the art that changes

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may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims, and that in some cases certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a control system for a press, means operative to supply alternately a cooling medium and a heating medium to the press, a timer, means operated upon the attainment of a predetermined temperature by said press to set up a circuit through which said timer may be operated, means to operate said timer thereafter, and means operated by said timer to produce adjustment of said supply means to turn off the supply of heating medium and turn on a supply of cooling medium a predetermined time after the timer has been operated.

2. A control system for a press having a stationary part and a movable part movable into and out of engagement with said stationary part, supply means to supply alternately a heating and a cooling medium to said press, means to maintain the temperature of said press constant during the time the heating medium is supplied thereto, means operated upon the attainment of a predetermined temperature in said press, and mechanism operated by said last named means to control the movement of said movable part into engagement with said stationary part.

3. A control system for a press having a stationary part and a movable part movable into and out of engagement with said stationary part, supply means to supply alternately a heating and a cooling medium to said press, a timer, means to set up a circuit upon the attainment of a predetermined temperature of said press through which said timer may be operated, means to operate said timer thereafter, means operated by said timer to control the movement of said movable part into engagement with said stationary part, and means also operated by said timer after said parts have been in engagement a predetermined time to control the adjustment of said supply means to turn off the supply of heating medium and turn on a supply of cooling medium.

4. In a control system for a press having a stationary part and a movable part movable into and out of engagement with said stationary part, means to supply a heating medium to said press, means to be operated upon the attainment of a predetermined temperature of said press to move said movable part of the press into engagement with the stationary part thereof, means operated after said parts have been in engagement a predetermined time to adjust said supply means to supply a cooling medium to said press, and means operated when said press reaches a predetermined minimum temperature to control the separation of said movable part from said stationary part and control the operation of said supply means to again supply a heating medium to said press.

5. A control system for a press having a stationary part and a movable part that may be moved into and out of engagement with the stationary part, moving means to move said movable part, supply means to supply alternately a cooling and a heating medium to the parts, a timer, temperature responsive means responsive to the temperature of said press, means operated by said temperature responsive means upon the

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attainment of a predetermined maximum press temperature to set up a circuit through which said timer may be operated, means to operate said timer thereafter, means operated by said timer to control the movement of said press parts together, means also operated by said timer after a predetermined period to control the adjustment of said supply means to supply a cooling medium to said press, and means operated by said temperature responsive means after said press has attained a predetermined minimum temperature to control the operation of said moving means to separate said press parts.

6. In a control system for a press having a stationary part and a movable part moved into and out of engagement with said stationary part, means to supply a heating and a cooling medium to said press, moving means to move said press parts together, means operative after said parts have been together a predetermined time to control the operation of said supply means to supply a cooling medium to the press, means responsive to the temperature of said press and operative when the temperature thereof reaches a predetermined minimum to control the operation of said moving means to separate the press parts and said supply means to supply a heating medium to said press.

7. In a control system for a press having a stationary part and a movable part adapted to be moved into and out of engagement with said stationary part, supply means adjustable to supply alternately a heating and a cooling medium to said press, a timer, means operated by said timer to produce movement of said parts of the press together while said supply means is adjusted to supply a heating medium to the press, means responsive to the temperature of said press, means operated by said timer after a predetermined time to control the adjustment of said supply means to cut off said supply of heating medium and turn

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on a supply of cooling medium, and means operated by said temperature responsive means when the press temperature has reached a predetermined value to cause said press parts to open and to adjust said supply means to cut off the supply of cooling medium.

8. A control system for a press having a stationary part, and a movable part to be moved into and out of engagement with said stationary part, means to move said movable part, mechanism to control said means to move, supply means adjustable to supply alternately a heating and a cooling medium to said press, means responsive to the temperature of said press, means operated by said responsive means when said press reached a predetermined temperature to place said mechanism in a condition to operate said first means to move said movable part into engagement with said stationary part, means operated a predetermined time after said parts have been in engagement to adjust said supply means to turn off the supply of heating medium and turn on a supply of cooling medium, and means operated by said responsive means upon the attainment by said press of a given minimum temperature to produce operation of said means to move said movable part in a direction to separate said parts.

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